Perspective

Sanitation Systems (/perspective/sanitation-systems-perspective)

Section

Sanitation Technologies (/sanitation-systems/sanitation-technologies)

Factsheet

Composting Chamber

العربية (/ar/sanitation-systems/sanitation-technologies/composting-chamber)

Applicable to

System 2 (/humanitarian-crises/rural-settings/sanitation/sanitation-systems/system-2%3A-waterless-pit-system-without-sludge-production)

Application level

- City
- Household
- Neighborhood

Management level

- Household
- Public
- Shared

Inputs

Faeces, Excreta, Organics, + Dry Cleansing Materials

Outputs

Compost, Effluent

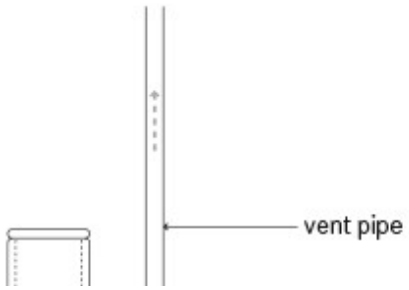
Author/Compiled by

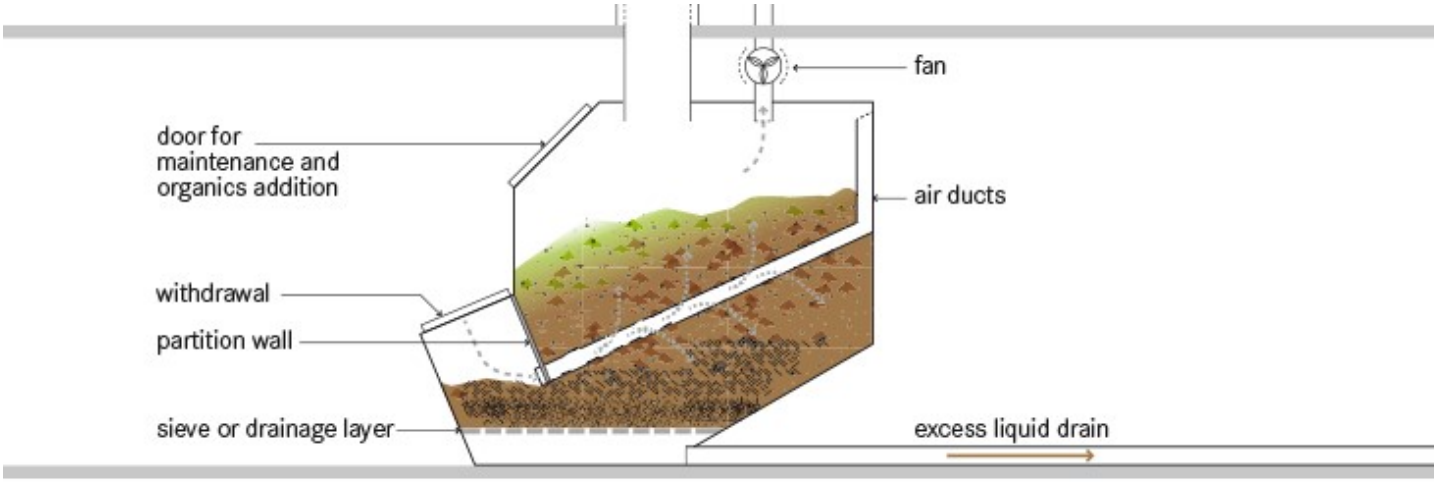
Eawag (Swiss Federal Institute of Aquatic Science and Technology)

Dorothee Spuhler (seecon international gmbh)

Adapted from

Compendium of Sanitation Systems and Technologies. 2nd Revised Edition (/node/5587)





Executive Summary

Composting refers to the process by which biodegradable components are biologically decomposed by microorganisms (mainly bacteria and fungi) under aerobic conditions. A composting chamber is designed to convert excreta and organics into compost. Compost is a stable, inoffensive product that can be safely handled and used as a soil conditioner.

Advantages

- Significant reduction in pathogens
- Compost can be used as a soil conditioner
- No real problems with flies or odours if used and maintained correctly (i.e., kept dry)
- Organic solid waste can be managed concurrently
- Long service life
- Low operating costs if self-emptied

Disadvantages

- Requires well-trained user or service personnel for monitoring and maintenance
- Compost might require further treatment before use
- Leachate requires treatment and/or appropriate discharge
- Requires expert design and construction
- May require some specialized parts and electricity
- Requires constant source of organics
- Manual removal of compost is required

In	Out
Faeces, Excreta, Dry Cleansing Material, Organics	Fertiliser, Compost/Biosolids, (Fertigation Water)

Introduction

This technology usually requires four main parts: (1) a reactor (storage chamber); (2) a ventilation unit to provide oxygen and allow gases (CO2, water vapour) to escape; (3) a leachate collection system and (4) an access door to remove the mature product.

Excreta, food waste and bulking material (such as wood chips, sawdust, ash or paper) are mixed in the chamber. There are four factors that ensure the good functioning of the system: (a) sufficient oxygen, provided by active or passive aeration; (b) proper moisture (ideally 45 to 70% moisture content); (c) internal (heap) temperature of 40 to 50 °C (achieved by proper chamber dimensioning); and (d) a 25:1 C:N ratio (theoretically) which can be adjusted by adding bulking material as a carbon source.

In practice, these optimal conditions are difficult to maintain. As a result, the output product is often not sufficiently stabilised and sanitised, and requires further treatment.

Design Considerations

A composting chamber can be designed in various configurations and constructed above or below ground, indoors or with a separate superstructure.

A design value of 300 L/person/year can be used to calculate the required chamber volume.

Ventilation channels (air ducts) under the heap can be beneficial for aeration. More complex designs can include a small ventilation fan, a mechanical mixer or multiple compartments to allow for increased storage and degradation time. A sloped bottom and a chamber for compost withdrawal facilitate access to the final product. A drainage system is important to ensure the removal of leachate.

Excessive ammonia from urine inhibits the microbial processes in the chamber. The use of a **Urine-Diverting Dry Toilet UDDT (/taxonomy/term/2660/uddt)** or **Urinal (/humanitarian-crises/camps/sanitation/user-interface/waterless-urinals-and-flush-urinals)** can, therefore, improve the quality of the compost (see also **urine diversion components (/sswm-solutions-bop-markets/affordable-wash-services-and-products/affordable-technologies-sanitation/urine-diversion-components)**).

Health Aspects/Acceptance

If the composting chamber is well designed, the users will not have to handle the material during the first year.

A well-functioning composting chamber should not produce odours. If there is ample bulking material and good ventilation, there should be no problems with flies or other insects. When removing the final product, it is advisable to wear protective clothing to prevent contact with (partially) composted material.

Operation & Maintenance

Although simple in theory, composting chambers are not that easy to operate. The moisture must be

controlled, the C:N ratio must be well balanced and the volume of the unit must be such that the temperature of the compost pile remains high to achieve pathogen reduction. After each defecation, a small amount of bulking material is added to absorb excess liquid, improve the aeration of the pile and balance the carbon availability. Turning the material from time to time will boost the oxygen supply.

A squeeze test can be made to check the moisture level within the chamber. When squeezing a handful of compost, it should not crumble or feel dry, nor should it feel like a wet sponge. Rather, the compost should leave only a few drops of water in one's hand. If the material in the chamber becomes too compact and humid, additional bulking material should be added. If a UDDT is used, some water should be added to obtain the required humidity.

Depending on the design, the composting chamber should be emptied every 2 to 10 years. Only the mature compost should be removed. The material may require further treatment to become hygienically safe (e.g., **Co Composting (/sswm-university-course/module-6-disaster-situations-planning-and-preparedness/further-resources/%28co-%29-composting-%28large-scale%29)**).

With time, salt or other solids may build up in the tank or drainage system. These can be dissolved with hot water and/or scraped out.

Applicability

Since this technology is compact and waterless, it is especially suited in areas where land and water are limited, or when there is a need for compost. It can also be installed in rocky areas, or where the groundwater table is high. In cold climates, a composting chamber should be indoors to ensure that low temperatures do not impede the microbial processes. This technology cannot be used for the collection of anal cleansing water or greywater; if the reactor becomes too wet, anaerobic conditions will cause odour problems and improper degradation.

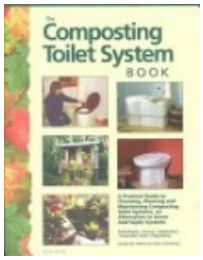
Library References

Technology Review of Composting Toilets

This GIZ publication explains the design, use and operational requirements of composting toilets. Ample examples for composting toilets from around the world are included in the publication to show that these types of toilets have a wide range of applications under a variety of circumstances (for wealthy or poor people; for cold, hot, wet or dry climates; for urban or rural settings). The appendix contains a listing of suppliers.

BERGER, W. (2011): Technology Review of Composting Toilets. Eschborn: Deutsche

The Composting Toilet System Book



Gesellschaft für Internationale Zusammenarbeit (GIZ) **URL (https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/878)** [Accessed: 12.05.2019]

The Composting Toilet System Book is an impressive, comprehensive, reader friendly, and practical guide to choosing, planning and maintaining composting toilet systems for those seeking an alternative to traditional sewer and septic tank systems. It explains the technologies, sources, applications, greywater issues, and regulations relevant to a composting toilet system for the home, whether manufactured or site-built.

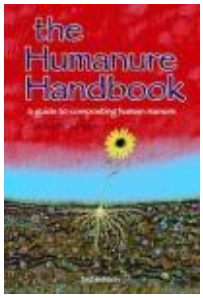
DEL PORTO, D. STEINFELD, C. (1999): The Composting Toilet System Book. A Practicle Guide to Choosing, Planning and Maintaining Composting Toilet Systems, an Alternative to Sewer and Septic Systems. Concord: Center for Ecological Pollution Prevention (CEPP)

Composting Toilets a Misnomer: Excessive Ammonia from Urine Inhibits Microbial Activity yet Is Insufficient in Sanitizing the End-Product

End-product from 16 public mixed latrine style composting toilets (CTs) at 12 sites between 50 and 2100 m.a.s.l. in Western North America was tested in order to evaluate the effect of composting variables on compost quality and hygiene.

HILL, G. B. ; BALDWIN, S. A. ; VINNERAAS, B. (2013): Composting Toilets a Misnomer: Excessive Ammonia from Urine Inhibits Microbial Activity yet Is Insufficient in Sanitizing the End-Product. In: Journal of Environmental Management: Volume 119 , 29-35. **URL (https://www.researchgate.net/publication/235716619_Composting_toilets_a_misnomer_Excessive_ammonia_from_urine_inhil product)** [Accessed: 12.05.2019]

The Humanure Handbook



A comprehensive book on recycling human excrement without chemicals, high technology or pollution. Well written, practical, and thoroughly researched, this self-published book is built on nearly twenty years of experience by the author, who tells us about every aspect of dealing with excrement on the home-scale level. Only available for free as web book.

JENKINS, J. (2005): The Humanure Handbook. A Guide to Composting Human Manure. (= 3rd Edition). Grove City: Joseph Jenkins Inc. **URL (http://humanurehandbook.com/contents.html)** [Accessed: 16.08.2010]

Water Efficiency Technology Fact Sheet - Composting Toilets

Factsheet including information related to microbial die-off rates and health risks.

U.S. EPA (1999): Water Efficiency Technology Fact Sheet - Composting Toilets. Washington D.C. (USA): United States Environmental Protection Agency (US EPA), Office of Water. EPA 832-F-99-066 **URL (https://www.epa.gov/sites/production/files/2015-06/documents/comp.pdf)** [Accessed: 12.05.2019]